



EERC

EERC Technology... Putting Research into Practice

The Plains CO₂ Reduction (PCOR) Partnership

Phases II and III Updates

**North Dakota Oil and Gas
Research Council Meeting**

June 26, 2007



PCOR Partnership

Phase II Goals

- Increase public understanding of CO₂ sequestration
- Perform field validation tests that develop:
 - Monitoring, mitigation, and verification (MMV) protocols.
 - Regional sequestration strategies.
 - Best separation/source matches.
 - Regulatory and permitting strategies.
 - Environmental benefits and risks.
 - Information needed to monetize C credits.
- Continued regional characterization.
- Creating a vision for practical environmentally sound carbon management strategies

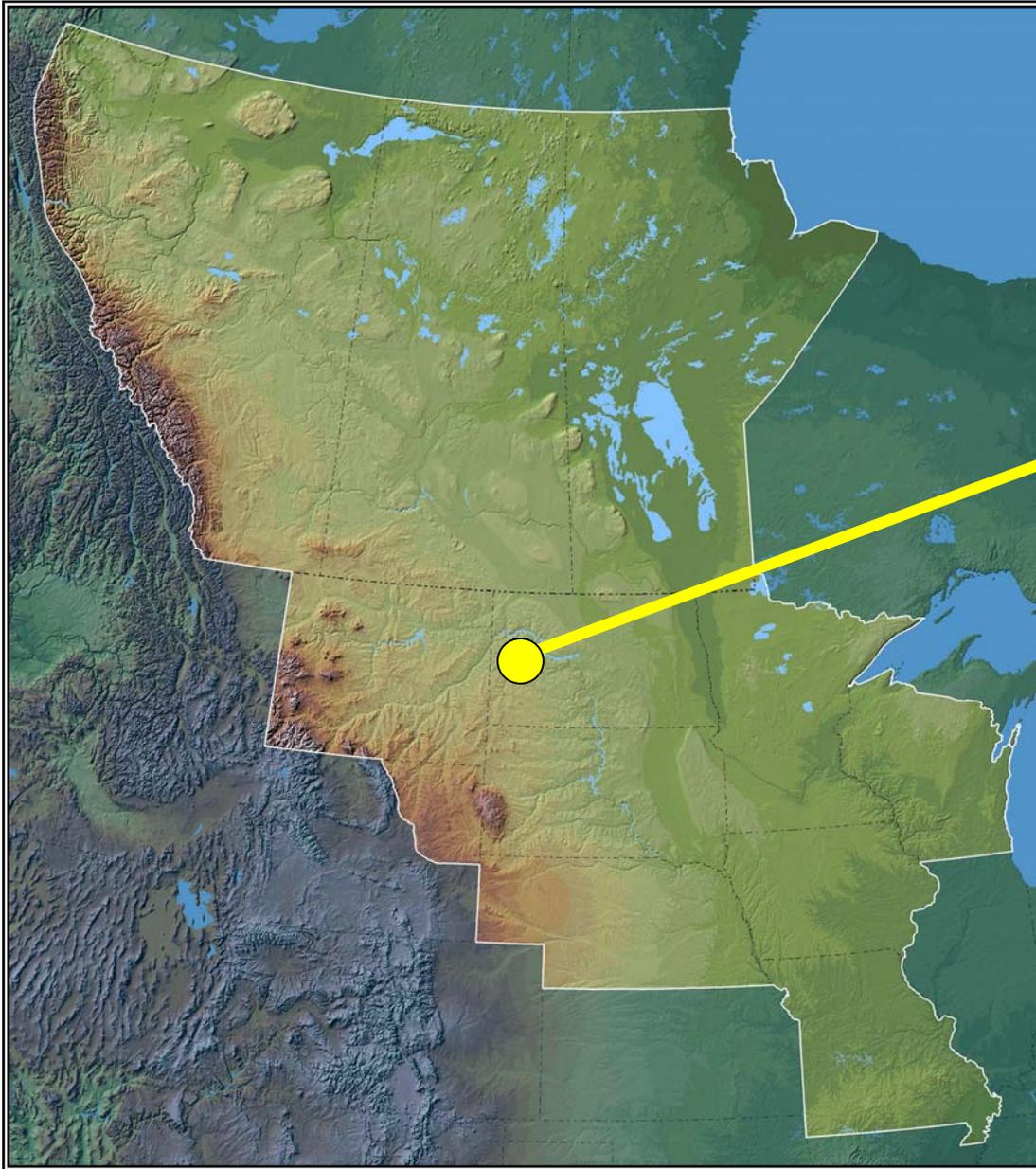
The PCOR Partnership has over 65 partners who represent public agencies, utilities, oil and gas companies, engineering firms, associations and nonprofit organizations, and universities.



PCOR Partnership Phase II – Regional Field Verification Activities



Williston Basin Oil Field



- CO₂ in a deep oil reservoir – CO₂ will be injected into an oil-bearing zone.
- We are currently discussing alternate plans with Hess and others regarding revamped activities.

Williston Basin Demonstration Summary

- Discussions with Hess and others continue. Possible activities include:
 - Huff-and-puff-type CO₂ injection.
 - Small-scale injection into Bakken Formation.
 - Sharing data/modeling capabilities.
- Discussing possible alternative industrial partners and field tests.

Zama Acid Gas EOR Project



- One of four Alberta demonstration projects to receive royalty credits for injecting CO₂ for enhanced oil recovery (EOR).
- Approach combines acid gas disposal and CO₂ EOR.
- Potential to expand to over 600 additional pinnacles.

Zama Field Validation Test

- Injection started December 2006.
- Injecting approximately 90 tons of acid gas per day.
- Sequestration of 25,000 tons (375 MMcf) of CO₂ per year.
- Incremental production increase of 10%–15% of original oil in place (OOIP).



Zama Field Test Summary

- Implications for the Williston Basin include:
 - Better understanding of the effects of impurities such as H₂S on EOR activities.
 - Commercial-scale data and experience with acid gas injection coupled with EOR.
 - Developing cost-effective and industry-friendly MMV capabilities.

Lignite Field Validation Test

- Determine the accuracy with which CO₂ storage capacity in lignite coal can be predicted.
- Develop data regarding the potential of CBM to be produced from lignite coal as a by-product of CO₂ injection.
- Demonstrate cost-effective MMV technologies and protocols for:
 - CO₂ sequestration.
 - Enhanced coalbed methane (ECBM) in a lignite coal seam.





Lignite CBM Research Project
Burke County, North Dakota

Section 36, T. 159 N., R. 90 W.

 Well Locations

0 150 300 450 600 Feet

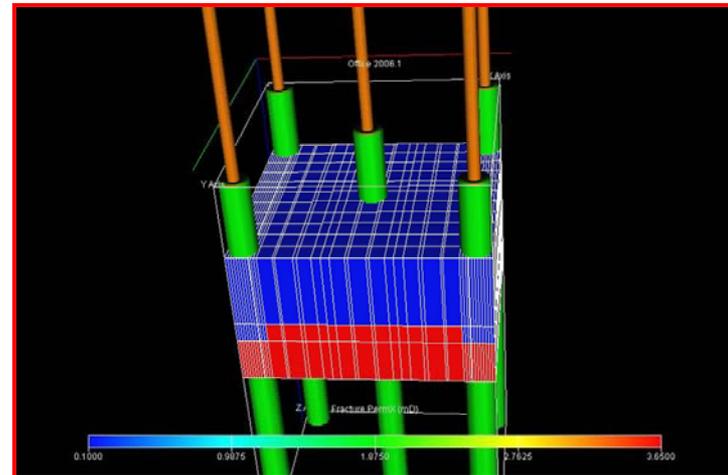


Location Map

- Drill and complete five wells
- Complete center well for CO₂ injection

Testing Program

- Baseline data collection
 - Analyze available logs in vicinity of test site
- Create numeric model (Eclipse)
- **Formation logging**
- **Core studies**
- Anticipated field tests
 - Pump test
 - Completion techniques
 - Leak-off test



Core Studies

- Gas content
- Gas specific gravity
- CH₄ and CO₂ isotherms
- Diffusion coefficient
- Gas desorption kinetics
- Coal ash and moisture contents
- Coal density and compressibility
- Rock porosity and permeability



Lignite Field Validation

Test Next Steps

- Plan to drill early July and begin dewatering process by the end of Summer '07.
- Use acquired log data and in situ monitoring data to validate numerical model.
- Begin modeling CO₂ fate using validated model.
- Begin CO₂ injection.

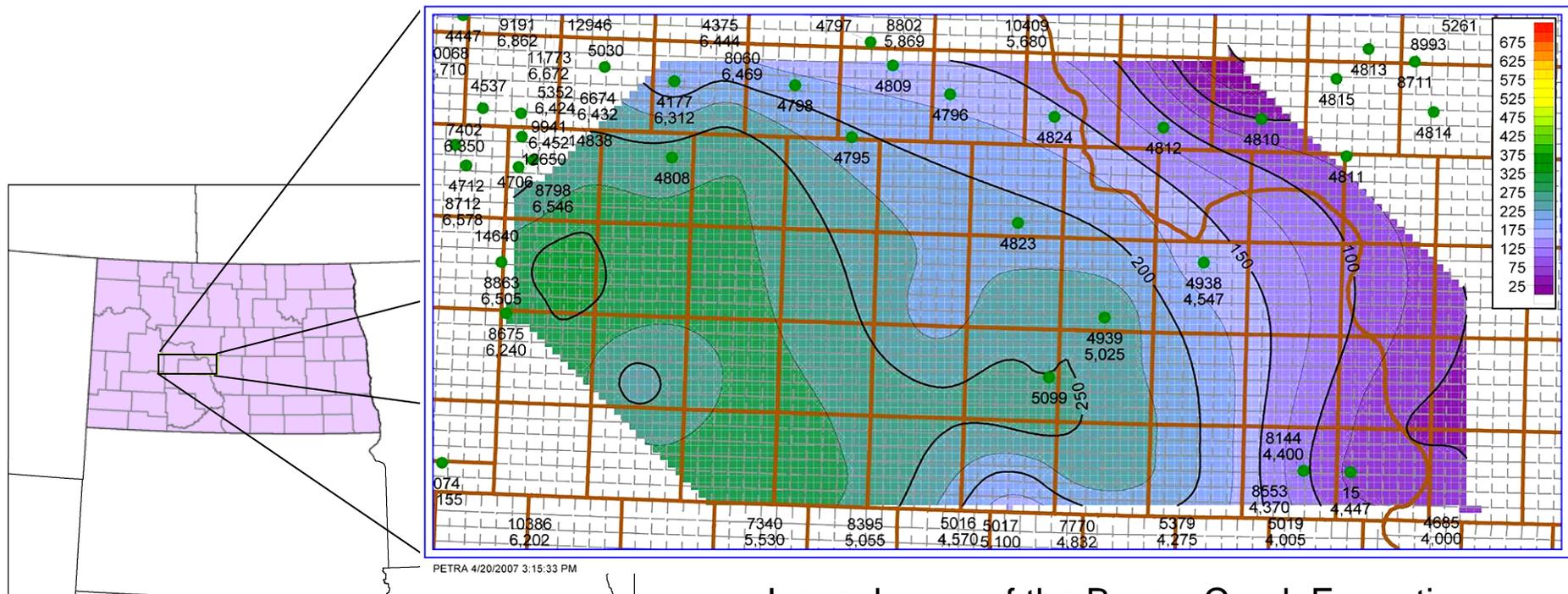
Lignite Field Test Summary

Implications for the Williston Basin include:

- Better understanding of the potential for CBM and/or ECBM from Williston Basin lignites.
- Better understanding of the potential CO₂ sequestration in Williston Basin lignites.
- Developing cost-effective and industry-friendly MMV capabilities.

Focused Characterization Efforts

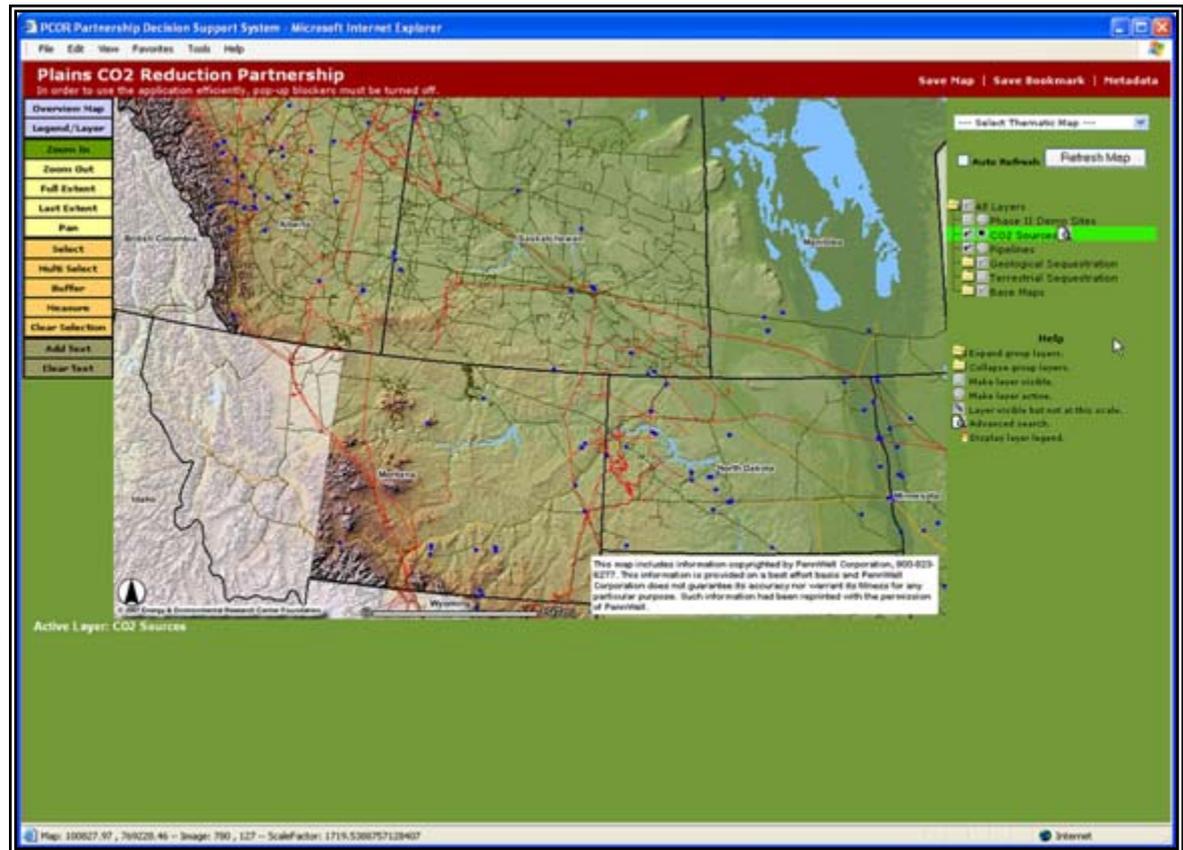
- More detailed evaluation of the CO₂ sequestration potential of saline formations in central North Dakota.



Isopach map of the Broom Creek Formation

Enhancement to the DSS

- Pipeline distribution system added showing routes and commodities.



Task 7 – Research Safety, Regulatory, and Permitting Issues

- Interstate Oil and Gas Compact Commission (IOGCC)
 - Carbon Capture and Geological Storage Regulatory Task Force
 - Developing model regulations dealing with site licensing, well operation, well/site closure, and long-term storage.
 - Legal Subgroup
 - Technical Subgroups
 - » Site Licensing and Well Operations
 - » Well/Site Closure and Long-Term Storage

Capture, Separation, and Transportation Technologies Task

Carbon Management Plans are being prepared for several planned facilities. These plans include:

- Overview of CO₂ capture technologies, dehydration, and compression.
- Pipeline transportation.
- Geologic sequestration options.
- Terrestrial sequestration options.
- Environmental and commercial risks.
- Carbon markets.
- Economic estimates.
- Conclusions/recommendations.



We Are Proposing Two Phase III Efforts

EERC ES29842.C

- A Williston Basin Project
- A Saline Formation Injection in Canada



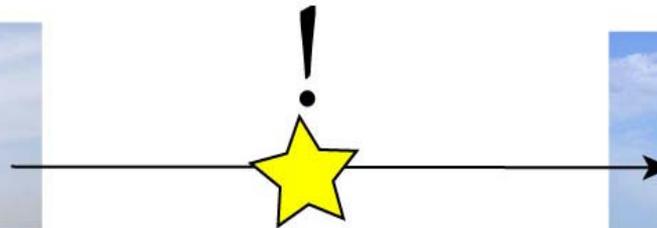
Williston Basin Phase III – Source

- Existing CFPP in central North Dakota.
- Encore and the EERC are in negotiation phase with multiple potential source partners.
- Minimum of 1 Mt/yr will be available.
- Western North Dakota ethanol plant may act as secondary source.



Williston Basin Phase III – Concept

- Capture at least 1 Mt/yr of CO₂ at existing CFPP in central North Dakota.
- Transport via pipeline to Encore oil field in Williston Basin.
- Meet or exceed all of the DOE Phase III objectives.
- Conduct MMV activities to document integrity of storage.
- Ultimately monetize credits.



Williston Basin Phase III – Philosophy

- North American oil production is reaching mature stages, and CO₂ is the future of tertiary oil recovery.
- EOR is a bridge technology for future large-scale implementation of CO₂ CCS.
- There is a tremendous capacity for sequestration in PCOR Partnership region oil fields (>3 billion tons).
- Absent other incentives, the economic component is critical for encouraging the widespread adoption of CCS in the PCOR Partnership region.

Williston Basin Phase III – Project Benefits

- First commercial-scale project to capture CO₂ from a retrofitted CFPP.
- First large-scale implementation of cost-effective MMV plan based on proven industrial technology applications and regulatory processes.
- Adaptation of existing technologies, methodologies, and frameworks to develop relevant regulatory process for large-scale CCS.
- Develop supporting evidence for the hypothesis that effective MMV need not be intrusive to field operations nor expensive to implement.



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